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EFFECT OF GROW REGULATORS ON THE STOMATA CONDUCTANCE IN THE APPLE TREE

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Abstract

This research paper presents the results of a field trial with managed yang orchard including apple cultivar Gala Galaxy, on the rootstocks M9. In November 2012, nursery tree "knip" were planted in the distance 3 m x 1 m. In the first vegetation season (2013) the experimental plot was separated in a randomized block system of four treatments. For research are taken 12 apple trees, which were treated with growth regulators in the stage of nursery trees production with Gerba 2.5% (benzyl adenine), Progebalin2.5%, (gibberellins A_{4+7} + benzyl adenine) Pinching (i.e. removal of terminal leaves)and Control (untreated). The stomata conductance was examined. During the period from July to September are realized 15 measurements. In each plant measurements made in 10 leaves (5 inside and 5 on the periphery of the crown of the tree). Also in same time made measurement temperature of leaf, soil temperature and moisture, to analyze the dependence between these ecological factors and stomata conductance. By the results obtained the treatment with GerBA 2.5%, has given higher values of leaf stomata conductivity (200.89 mmol m^{-2} s^{-1}) in relation to treatments, Progerbalinin, Pinching and Control, respectively; (174.76, and 141.94 162. 57 mmol m^{-2} s^{-1}). It is also remark that exist strong correlation between stomata conductance with soil moisture, soil and leaf temperature.

Key words: stomata conductance, grow regulators, ecological factors

Introduction

The process of plant function is quite complex and the impacted of many factors internal or external. It is quite important to recognition as more as possible of these factors were their role in the plants could be different. This could help us in some processes interfering with the aim of establishing an optimum balance in the development of plants. Apical dominance is the control exerted by the shoot apex over the outgrowth of the lateral buds (Cline, 2000). Also according Ibro (2008) the auxin have essential role in apical dominance respectively dominance top of the buds in relation with lateral. The development of lateral shoots is in direct correlation with the phenomenon of apical domination (Avdiu*et al.,* 2014; Martin, 1987; Cline, 1997; Wilson, 1994). Hormone production and assimilate retention by the branch are the most likely candidates for the primary causes of apical control (Wilson, 2000). Apical dominance is exerted by the shoot apex over the outgrowth of lateral buds in apple (Wang, 1994). The environmental impact on the organs of plants and their related functions is conditioned very much by the power and duration of certain factors, even by the interaction of the factor with genetic features of plants (Zlatev*et al.*, 2012). Defining and recognizing by vapour pressure deficit (VPD) as an environmental factor is necessary for the evaluation of evaporation - transpiration (since it is the part of equations that compute potential evapotranspiration - PET), but along with global radiation (GR) have the key impact on the stomata activity and transpiration (Tonello*et al.*, 2012; Mugani, 2004). Stomata of leaves are a mechanism through which is controlled the process of transpiration and absorption of CO_2 and according to Tonello*et al.*, (2012) when we want to determine the stoma response to various climatic factors, potential impacts may appear including all main elements that participate in leaf's function.

Materials and methods

To establish of experimental orchards selected the standardized apple nursery “knip” tree with cultivar‘Gala Galaxy’, on the rootstock M9 at the distance 3 m x 1 m. For research 12 apple trees were taken (3 for each variant), which were treated with growth regulators in the stage of nursery trees production GerBA2.5% (benzyl adenine), and Progebalin 2.5%, (gibberellins A_{4+7} + benzyl adenine). Besides, two other treatment were included: pinching (i.e. removal of terminal leaves) and control (untreated).

The soil in which saplings were planted was of good quality, up to 60 cm deep and in average contained: humus 2.36 %, (moderate) N 0.13 % (moderate), P_2O_5 10.69 mg/100g (low), soil, K_2O 43 mg/100g soil (high), Ca101.73 mg/100g soil (moderate), Mg 47.14 mg/100g soil (moderate). pH value in water was 6.8 whereas in KCl 5.8 (slightly acid)

Ploughing was made at 50 cm depth, organic and mineral fertilizer was distributed in advance: organic 5kg/m^2 and mineral NPK 15:15:15 100g/m^2.The plot was tilled 5 times; plants were drip irrigated and have received 3 treatments with fungicides and insecticides.

The model and experiment design

For research is taken stomata conductance and impact of ecological several factors which connected with this process inside of the 10.07 - 06.09.2013 period.

In 12 plans taken for research, 12 measurements were carried, where in each plant are selected 10 leaves for measurements (5 inside and 5 outside the apple tree shape). In same time to the all cases, exanimate temperature of leaves. The Porometer measures stomata conductance using a sensor head with a fixed diffusion path to the leaf. It measures the vapor concentration at two different locations in the diffusion path. It computes vapor flux from the vapor concentration measurements and the known conductance of the diffusion path using the following equation:

$$\frac{CvL - Cv1}{Rvs + R1} = \frac{Cv1 - Cv2}{R2}$$

Where CvL is the vapour concentration at the leaf, Cv1 and Cv2 are the concentrations at the two sensor locations, Rvs is the stomata resistance, and R1 and R2 are the resistances at the two sensors. If the temperatures of the two sensors are the same, conductance can be replaced with relative humidity, giving:

Conductance is the reciprocal of resistance, so gvs = 1/Rvs.

The soil temperature depth 15 cm measured with Sensor type ”WET 2” whereas the soil moisture in two levels 20 and 40 cm depth, measured with “DELMHORS” Sensor.

$$Rvs = \frac{1 - h1}{h1 - h2} R2 - R$$

Results and discussion

Stomata conductance is an important indicator that shows that the behaviour of the stomata is a necessary reaction of the plant to climate factors. Through them, it controls two important physiological processes; transpiration and absorption of CO_2 that is the basis for photosynthesis. Tonelloet *et al.*, (2012) point out that when we want to determine the reaction of stomata to different climatic factors, potential impacts may pluck including all the main elements that take part in the functions of the leaf.

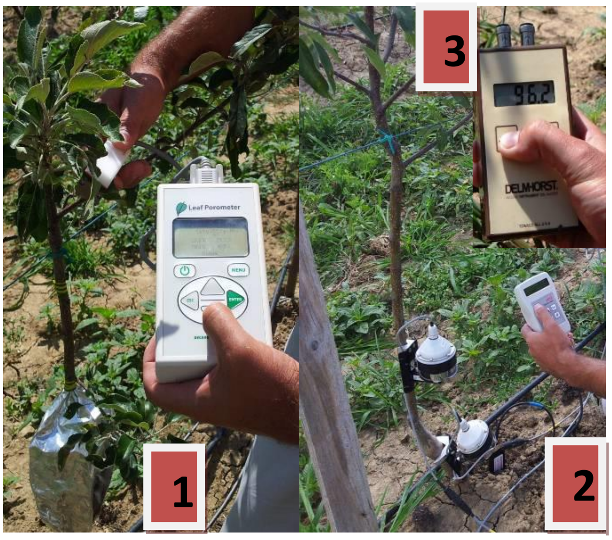

Figure 1. The process of measures: 1.Porometer (stomata conductance), 2. Delmhorst (soil moisture 20-40 cm depth), 3. WET 2 (soil temperature 15 cm depth)

Table 1. Obtained means for some ecological and physiological factors during the period 10.07-06.09.2013 to the apple cultivar "Gala Galaxy" on the rootstock M9

Date	Soil moisture (20-40cm) KS-D1	Soil temp. ºC (0-15cm)	Leaf temp. ºC	Stomata conductance mmol m^{-2} s^{-1}			
				Progerbalin 2.5%	Gerba 2.5%	Pinching	Control
10.07. 13	96.00	23.80	21.93	123.9	144	117.5	102.7
13.07. 13	96.20	26.87	28.52	195	229	207.6	173.5
16.07. 13	96.30	21.67	19.83	124.2	122.3	123.2	147.1
19.07.13	96.80	32.47	31.83	179.9	225.4	186.3	171.4
22.07. 13	96.35	31.07	29.68	198.1	212.5	174.2	139.4
25.07. 13	92.30	31.00	33.85	163.5	176.6	165	115.8
29.07. 13	74.90	33.63	36.15	159.1	165.5	131.6	95.38
31.07. 13	69.60	30.67	28.87	180.9	190.4	189.8	157.4
03.08. 13	63.85	35.40	34.54	122.6	176.7	95.54	77.26
06.08. 13	80.40	31.80	35.67	138.4	141.8	113.6	84.32
09.08. 13	60.62	37.93	37.34	132.3	141.2	88.68	63.42
28.08. 13	95.9	27.93	29.18	220.1	242.8	207.1	212.5
31.08. 13	95.75	27.93	26.75	230.6	310	226.6	223.4
03.09. 13	94.95	25.30	27.33	260.9	299.4	250.5	218.3
06.09. 13	94.95	29.30	29.05	191.7	232.6	161.3	176.4

The data presented in Figure 2 shows that existed a strong connection between stomata conductance and soil moisture, temperature soil and leaf. Another interesting phenomenon that finds compliance with studies of Cechin*et al*., (2010), is that the fall of stomata conductance of leaf aging, which stands very well in the last part of the above figure that coincides with the decade first of September. In this case, although temperature and humidity indicators remain almost constant values, whereas have a noticeable decrease of stomata conductance for all variants.

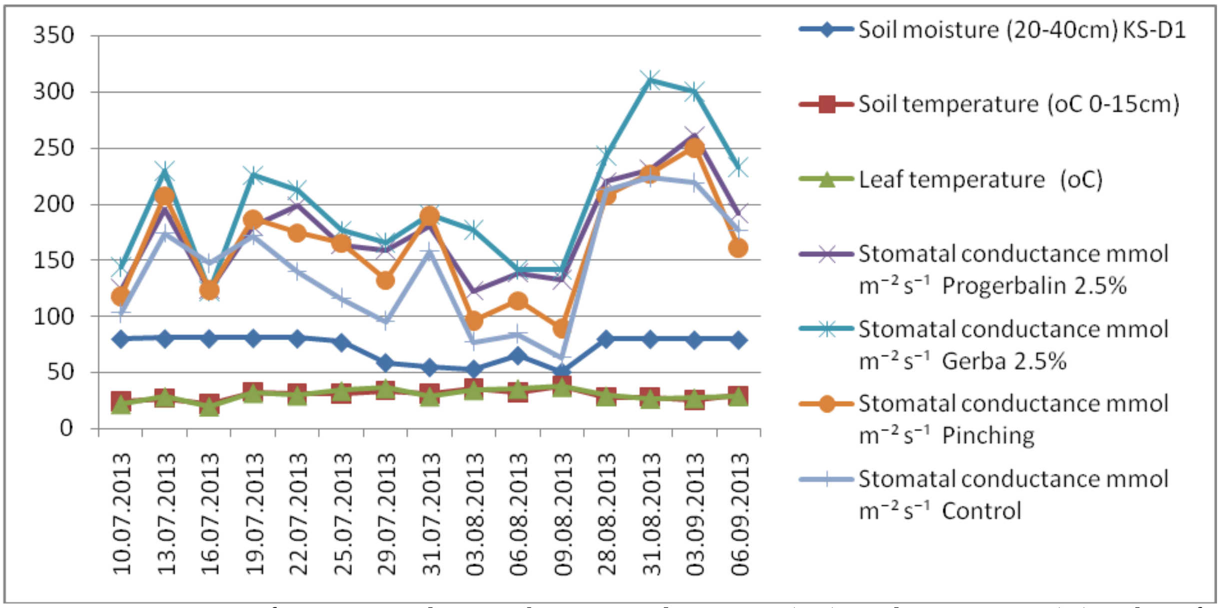

Figure 2. Comparison of stomata conductance between Soil moisture (Sm), Soil temperature (St) and Leaf temperature (Lt) according the variants

According to the results obtained on the stomata conductance presented in the Table 2 and Figure 3, distinguish the difference between the average values achieved in each of the analyzed variant. The variant treated with Gerba 2.5%, has given higher values leaf's stomata conductance (200.89 mmol m-^{2} s-^{1}) in relation to options, Progerbalin, Pinching and Control respectively; (174.76, 162. 57 and 141.94 mmol m-^{2} s-^{1}).

Table 2. Comparison of several statistical descriptive parameters of stomata conductance (mmol m^{-2} s^{-1}) means, control and three (Progerbaline, Gerbadhe Pinching) during the comparison period

Level	Mean	Significantly different
Gerba 2.5%	209.58*	A
Progerbalin 2.5%	182.79	AB
Pinching	170.09	AB
Control	150.55	B
Means Comparisons	q*	Alpha
Tukey-Kramer HSD	2.64794	0.05
	3.25848	0.01

Levels not connected by same letter are significantly different, * significantly in level 0.05,

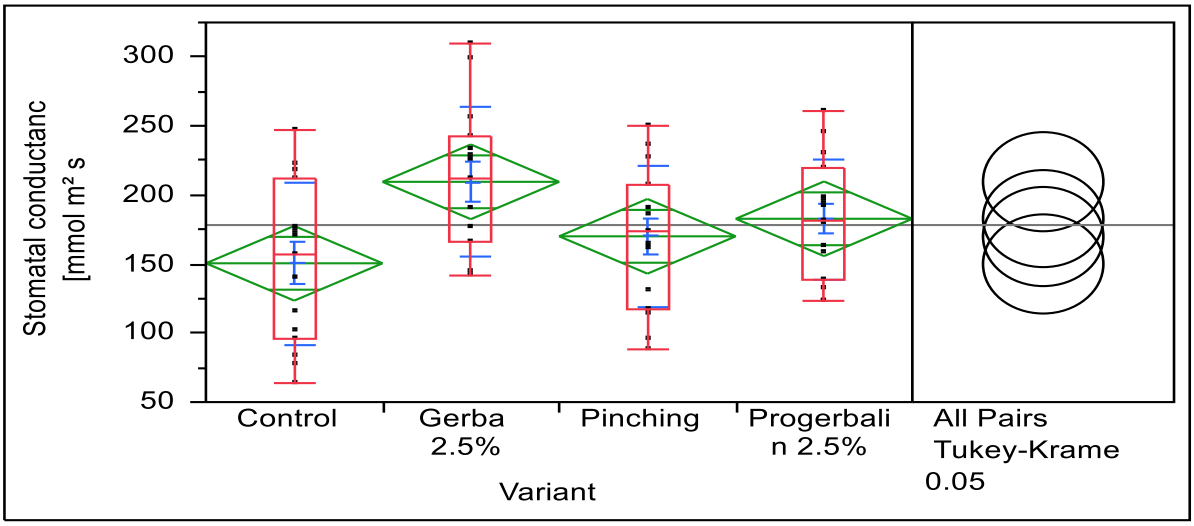

Figure 3. Stomata conductance [mmol m^{-2} s^{-1}] by Variants Gerba2.5%, Progerbalin 2.5%, Pinching and Control

Conclusions

Reduction of moisture in soil stimulates ABA synthesis of the root that further is transported through xylem up to the leaves and causes a slight closure of stoma, whereas, cytokinin stimulate the opening of the stoma and transpiration growth rates (Kullaj*et al.*, 2014; Mameli, 2007). This cytokinin effect to the stoma opening is associated with water potential in the other parts of the plant. There occur several interactions between cytokinins, ABA and CO_2 concentration (Blackman and Davies, 1984; Das and Raghavendra, 1976). Decagon, (2006) emphasizes that the conductance is reciprocal with the stomata resistance. This means that trees derived from seedlings treated with grow regulator of cytokinins content (Gerba 2.5%) have higher stomata conductance but lower resistance, while the opposite is true for trees untreated (control) which have lower stomata conductance and higher resistance of stoma. This brought the stoma, match quite well with ecological factors as soil moisture, temperature soil and leaf, but to take into consideration the development phase of the plant within the vegetation.

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